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PRODUCTION of CLEAN MILK

CLEAN MILK, as meant in this bulletin, is milk that comes from healthy cows, is of good flavor and free from dirt, and contains only a small number of bacteria, none of which are harmful.

Disease-producing bacteria which get into milk are most likely to come from unhealthy cows, unhealthy persons who do the milking, contaminated water, flies, or filth.

Great numbers of bacteria may get into the milk from the body of the cow and from utensils which have not been treated with heat (steam or boiling water) or a chlorine solution.

The number of bacteria may be kept at a minimum in milk by cleaning the cows, by using small-top milk pails, and by thoroughly washing the utensils and then treating them with heat or a chlorine solution.

Prompt cooling and storage at low temperatures retards the growth of bacteria in the milk. Milk so handled keeps better and makes products of a higher quality.

Clean, well-constructed stables, and separate milk rooms for handling the product, are important factors in the production of clean, wholesome, high-quality milk and cream.

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PRODUCTION OF CLEAN MILK

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WHAT IS CLEAN MILK?

STRICTLY SPEAKING, the term "clean" would exclude milk which contains any foreign matter or bacteria whatever. However, for practical purposes, "clean milk" is defined here as milk that comes from healthy cows, is of good flavor and free from dirt, and contains only a small number of bacteria, none of which are harmful.

IMPORTANCE OF PRODUCING CLEAN AND WHOLESOME MILK

THE PRODUCER'S INTEREST

Every year the dairy farmers of the United States suffer heavy financial losses because too large a proportion of the products which they market is lower in quality than it should be. It is conservatively estimated that they could add many millions of dollars annually to their income, simply by giving attention to those factors which make for high quality of product. Sour and off-flavored milk and cream are not readily marketable, and when the dairyman does find a market the price he gets is usually low as compared with what he might get for a product of high quality. Furthermore, the products made from low-quality milk and cream are usually low in quality, so the losses from low-grade milk and cream extend all along the line. On the other hand, milk and milk products of high quality not only bring better prices but tend to increase consumption and thereby extend the dairymen's market.

[1] The original edition of this bulletin was written by Ernest Kelly.

In the flush season of milk production dealers have the opportunity to select their supplies upon a quality basis. When the flush occurs those producers who offer low-quality milk are the ones who are weeded out of the best market. Low-quality milk is what the buyer rejects first. High-quality milk retains the market.

On the farm the milkers and all people who handle milk should realize that they have in their charge a food which is easily contaminated. Safeguarding the wholesomeness of the milk supply on the farm protects the health of the farm family, who use a part of the milk, and also protects the health of the calves, which live largely on milk.

Healthy cows to breed from, and pure milk to feed, are two important factors in rearing thrifty calves and in the development and maintenance of a healthy and profitable herd.

THE CONSUMER'S INTEREST

Until recently, milk was generally considered as a food for only infants and invalids. Milk is necessary for the growing child, and the adult has learned that milk is one of the most valuable of foods, because it is nourishing, economical, and easily digested. The consumer, however, will demand milk as a food only when he has confidence in its wholesomeness. Serious epidemics of typhoid fever, septic sore throat, and other diseases have been spread through milk which was not carefully produced or properly pasteurized. Evidence indicates that tuberculosis may be transmitted from animals to human beings, chiefly young children, by the consumption of raw milk containing tubercle bacilli. (Raw milk is milk that has not been pasteurized.) Health is endangered not only by milk that contains specific disease-producing bacteria, but also by milk that contains large numbers of certain other kinds of bacteria which may cause serious digestive troubles, especially in infants and invalids. Another consideration is the loss to the consumer from milk souring or otherwise spoiling before it can be used. The cleaner the milk the longer it can be kept in sweet, wholesome condition.

BACTERIA IN MILK

Bacteria are single-celled plants which are so small they can not be seen with the naked eye.

All milk, unless produced under very exceptional circumstances, contains some bacteria.

Milk furnishes ideal conditions and food material for bacterial growth. Some bacteria, at maturity, divide to form two bacteria, and under favorable conditions the two new individuals may become full-grown and repeat the process of division in from 20 to 30 minutes. The bacteria commonly found in milk multiply most rapidly at temperatures between 80° and 100° F. At 70° F. the rate at which the bacteria multiply is slower. At 50° F. the rate is still slower. At 40° F. and below the rate is very slow. However, a few kinds of bacteria continue to multiply even at the freezing point.

Many of the kinds of bacteria ordinarily found in milk cause no apparent change in the milk. Other kinds may change the flavor without changing the appearance. Some of the most common types

of bacteria cause marked changes in both appearance and flavor. In the latter class are the bacteria which sour milk by converting the milk sugar into lactic acid, and those which cause the formation of a sweet curd. Another type of bacteria decomposes the casein and albumin in the milk and causes putrefaction and undesirable odors.

The number of bacteria in milk depends upon the number of bacteria in the udder of the cow, upon the amount of contamination from outside sources, and upon the rapidity or the rate at which the bacteria increase in number.

It is very important to bear in mind that the rate at which bacteria grow and increase in number depends very largely upon the temperature at which the milk is kept.

KEEP DISEASE-PRODUCING BACTERIA OUT OF THE MILK

HEALTHY COWS

Tuberculosis probably is the most dangerous and widespread disease of cattle that can endanger the safety of milk. Tuberculosis is infectious. It spreads in a herd from cow to cow. As the disease develops slowly a cow may be affected with it for several months or even years before any marked physical changes in the animal are noted.

The total economic loss from tuberculosis is enormous. It amounts to millions of dollars a year. But far more important than this is human health.

Tuberculosis in dairy cows, especially in the udder, may be the source of tuberculosis in human beings. Most of the tuberculosis in children is in the bones, joints, and digestive tract, a fact which leads to the theory that milk may be one of the chief causes.

Have a capable veterinarian test the cows for tuberculosis at least once a year; and if disease is found, test twice a year. Remove from the herd all cows which react to the test, and disinfect the stable and premises thoroughly. See that all animals purchased for the herd are tuberculin-tested and free from the disease before they are brought to the farm. Keep them separate from the other animals for at least 60 days, and retest before placing them with the herd.

Infectious abortion of cattle is the cause of great losses to the cattle industries, and has a significance, of as yet undetermined importance, in respect to human health. This disease in cattle, and also in swine, is caused by a germ commonly known as *Bacterium abortus* or *Brucella abortus*. This germ has been found to sometimes cause undulant fever in man, the disease being acquired either through the consumption of the raw milk from abortion-infected cows or through contact with infected cattle or swine, or the carcasses of the latter. To avoid danger from this disease, milk should come from herds that are free from infectious abortion, or it should be pasteurized. The presence of infectious abortion in cattle may be detected by the use of the agglutination test for this disease. Infected herds may be freed from infectious abortion through the segregation and elimination of all reacting animals.

Milk that is slimy, ropy, or watery, or abnormal in any respect, or which comes from an animal that appears to be sick or out of condition, should not be consumed by human beings. As a rule, for

15 days before a cow calves and for 5 days after she calves, her milk should not be used as human food. It is well not to use milk from cows that have been given powerful drugs which may pass into the milk.

HEALTHY MILK HANDLERS

Some communicable diseases which do not originate with the cow may be carried by milk. The bacteria causing these diseases drop into the milk, are introduced unknowingly by the milker, are carried by flies, or come from the contaminated utensils.[2] Many of these bacteria grow in milk, and milk-borne epidemics have been caused by them. Some of the diseases which may be carried by milk are tuberculosis, typhoid fever, diphtheria, scarlet fever, and septic sore throat. The bacteria which cause these and some other diseases can be carried by people who are apparently well or well enough to work. Great care must be taken to have only healthy people handle the milk or anything with which the milk may come in contact. No one should go from a sick room where an infectious disease exists to take part in any of the operations where the milk is produced, handled, or kept.

PURE WATER

All the water on the farm should be pure, even that to which only the cattle have access. The farmer owes this protection to his family, to his business interests, and to the people who use the milk from his dairy. If cows wade in polluted water, disease bacteria, especially those causing typhoid fever, may adhere to them and later fall into the milk pail. Be sure that the water that is used for washing milk pails and other utensils is pure.[3]

DISPOSAL OF MANURE AND OUTHOUSE DEPOSITS

Disease may be spread from farm to farm and milk may become infected if care is not taken in the disposal of wastes from human beings and domestic animals. Disease-producing bacteria may be carried from exposed excreta by flies, rats, birds, etc., or they may be washed into the water supply. Stable manure and outhouse deposits should be disposed of in such a way that there is no possibility of their being a source of contamination of the milk.

Whenever possible, haul stable manure directly to the field and spread at once. When this is not feasible, put it in a covered storage pit or bin at a safe distance from the stable and milk house. Such treatment of manure not only protects health but saves valuable fertilizing materials. Figure 1 shows how manure is promptly removed from the barn on one good dairy farm.

The disposal of human excreta is highly important and can be easily accomplished in a number of ways. Indoor toilets, either chemical or connected with a sewer, are practical for farm homes. If outdoor privies are used they should be of sanitary type,[4] and the accumulations of material should be removed frequently and be either burned, treated with powerful chemicals, or buried.

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[2] The term "utensil" as used in this bulletin refers to any appliance which comes into contact with milk or cream during production or handling, such as milk pails, strainers, cans, separator parts, milk bottles, etc.

[3] Write your State board of health for information concerning farm water supplies.

[4] Write your State board of health for information concerning the construction and maintenance of sanitary privies.

CONTROL OF FLIES

Flies may carry millions of bacteria on their feet and bodies. They contaminate milk if they get on the utensils. They also mar the appearance of equipment, walls, ceilings, and windows, and annoy the animals and caretakers. They are attracted by the cattle, piles of manure, spilled milk, and other feeding or breeding grounds. Flies breed in moist, decaying vegetable matter, especially manure.

Keep corners of stalls clean, and clear away any feed there may be under the mangers. Early in the spring remove straw that has been banked around the watering troughs and buildings. In warm weather haul away the droppings from the lanes and yards every week. Where manure is piled in the open, haul it away at least once a week, from early spring until winter. Flies breed very freely in

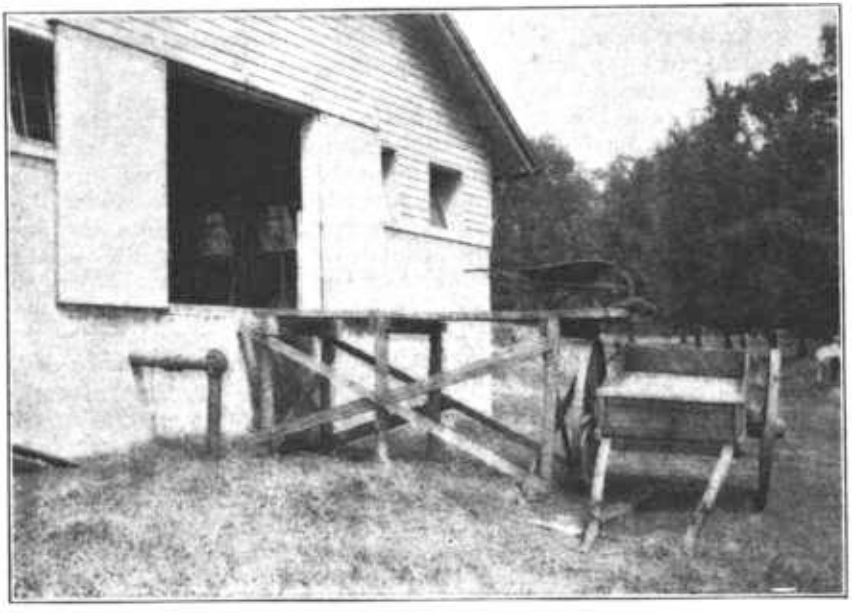

FIGURE 1.—A simple and efficient way to handle manure on a small dairy farm. The prompt removal of the manure from the barn directly to the field avoids loss of manure and also keeps the barnyard clean

calf manure, particularly if the calves are fed milk in any form. It is advisable to remove calf manure twice a week. Take away all the fine loose material under manure piles. This material is likely to be heavily infested, as the fly larvæ work toward the outer edge and bottom of the piles.

Immediately after the manure is removed, treat the ground that was under the pile with a 28–32 gravity fuel distillate (fuel oil), at the rate of 5 gallons to 100 square feet. This will kill the larvæ that have gone into the ground and may prevent others from going into the ground for some time. This distillate need be used but once every two or three weeks. Do not apply it directly on the manure because it contains substances that are injurious to plant growth.

Flies will find some place to breed even though conditions are not the most favorable. They may be killed by trapping and spraying.

The house fly is easily trapped. Put the traps in places where the flies gather, preferably on the floor, where air currents are not strong and where the light is good. The kind of bait is important. Either sugarcane blackstrap molasses or corn sirup mixed with water in the proportion of 1 part to 4 parts of water is effective. Watermelon rinds, crushed fruit, skim milk, and some of the grain feeds may be used, but they must be renewed oftener. Renew the bait, and thoroughly clean the pans every two or three weeks, or more often if mold starts to form on the bait. When adding bait, examine the cone of the trap for spiders.

Empty the traps regularly, as flies do not enter them readily when they become too full. The flies may be killed by steaming the traps in the steam box for three to five minutes. This will kill the live flies and loosen any dirt there may be in the trap. If steam is not available, either put the traps in water for a few minutes or pour hot water over them. Then wash the traps and allow them to dry in the sun before replacing them over the bait pans.

Spray the places where the flies gather. Do this early in the morning when the flies are somewhat sluggish, and late in the afternoon after they have fed and gathered for the night. Also spray their feeding places after large numbers have gathered on them. When flies are unusually annoying to the cows it may be well to spray the animals. Do not force the spray directly into the hair. Direct the spray parallel to the animals so as to hit the flies as they rise. Do not brush the cows for some time afterwards. Horn flies must be sprayed while on the cattle, as they stay in no other place long enough to be hit with the spray.

Use a sprayer of good size, capable of standing a pressure of 35 to 40 pounds, with a nozzle that will throw a heavy, fully atomized spray over a considerable area. An 8-foot bamboo extension will allow the operator to reach the ceilings and out-of-the-way places. If the manure is hauled away promptly, thorough spraying need be done only three times a week.

A good killing spray can be made as follows: Put 5 pounds of unground, half-closed pyrethrum flowers in a double-thickness cheesecloth container. Suspend this for 24 hours in a mixture of 9 gallons of kerosene and 4 quarts of fuel oil of 28–32 gravity. Some of the insecticide manufacturers sell a concentrated pyrethrum extract which needs only the addition of the kerosene and fuel oil.

PREVENT HIGH BACTERIAL COUNTS IN THE MILK[5]

Most of the bacteria in milk come from the body of the cow and from unclean milk utensils. Under certain conditions the bacteria may multiply until the number becomes very large. To keep the bacterial count low, keep the body of the cow clean, have all utensils thoroughly clean and sanitary, use small-top milk pails, keep flies and all sources of bacterial contamination away from the milk, and cool the milk promptly after milking and keep it cool.

[5] The bacterial count is the number of bacteria found in a cubic centimeter, and is determined by allowing the bacteria from a definite quantity of milk to grow on a culture medium and counting the number of colonies, each of which represents the growth from one bacterium.

CLEAN COWS

The body of the cow, especially those parts of the belly, flanks, and udder that are immediately above the milk pail, may be the source of bacterial contamination, because manure, loose hairs, bedding, and other foreign matter may fall into the milk pail. Samples of fresh manure have been found to contain nearly 50,000,000 bacteria per gram. (There are 453.6 grams in a pound.)

Have the cows clean at milking time. Cows usually keep cleaner when they are on pasture than when kept in the barn, but although they appear to be clean they may be very dusty and therefore need to be brushed. (Fig. 2.) When the cows are in stables clean them

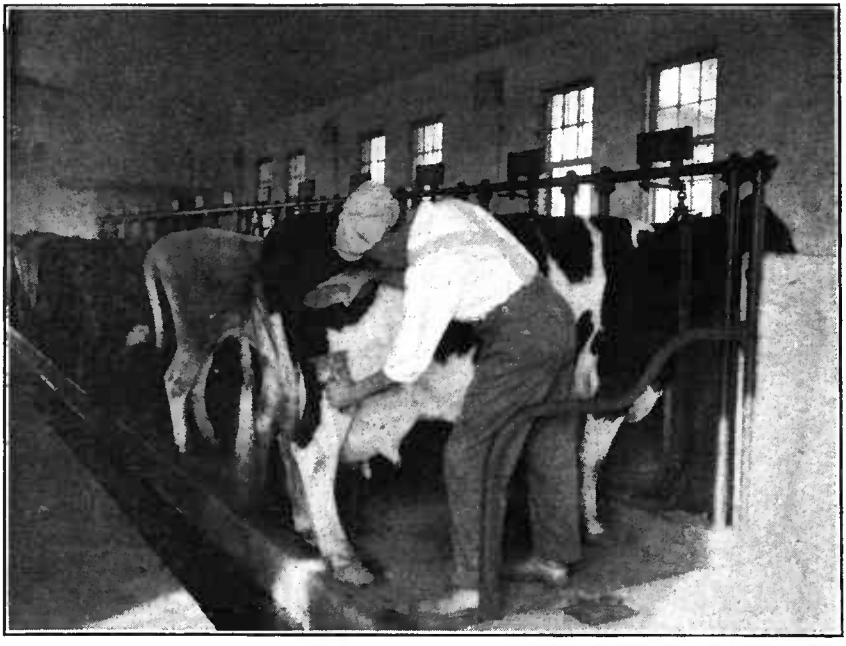

FIGURE 2.—Cleaning the cows in a modern dairy barn. Cleaning the cow is the first main step in the production of high-quality milk

thoroughly at least once a day. Clip the long hairs from their udders, flanks, and tails in order that dirt may not cling to them. Before milking, carefully wipe the udders, flanks, and bellies with a clean, damp cloth to remove dust and loose hairs. If these parts are very dirty, wash them. Plenty of bedding, good stables, and frequent removal of manure will help to keep the cows clean.

In an experiment made by the Bureau of Dairy Industry, fresh milk from dirty cows had an average bacterial count of 55,208 per cubic centimeter, whereas fresh milk from clean cows with udders and teats washed averaged only 4,947 per cubic centimeter. (A cubic centimeter is about 16 drops.) Open-top milk pails, thoroughly washed and treated with steam, were used.

SMALL-TOP MILK PAILS

Most of the dirt that gets into milk falls from the cow into the pail at milking time. There are fewer bacteria and there is less sediment in the milk when the small-top pail is used, than when an open-top pail is used. An experiment showed that the average number of bacteria per cubic centimeter in 30 samples drawn into a small-top pail was 29,263, whereas with the same number of samples drawn into an open pail the average was 87,380.

The small-top pail should be durable, have smooth seams, be easy to milk into, be easy to clean, and have only a small opening. A number of types of small-top pails are on the market. Any tinner can convert an ordinary open-top pail into a small-top pail at little cost, by putting on the hood shown at the right in Figure 3.

WASHING AND THEN TREATING UTENSILS WITH HEAT OR A CHLORINE SOLUTION

Utensils which have not been properly washed and treated to kill bacteria contain large numbers of bacteria. Indeed, dirty utensils are usually the source of most bacteria found in market milk at the time of production and before bacterial growth has begun. Experiments have furnished convincing proof of the fact that milk is contaminated by utensils that have not been subjected to heat or to treatment with a chlorine solution. In an experiment milk drawn into pails which had been thoroughly steamed had an average of only 6,306 bacteria per cubic centimeter, whereas samples from pails which had not been steamed averaged 73,308.

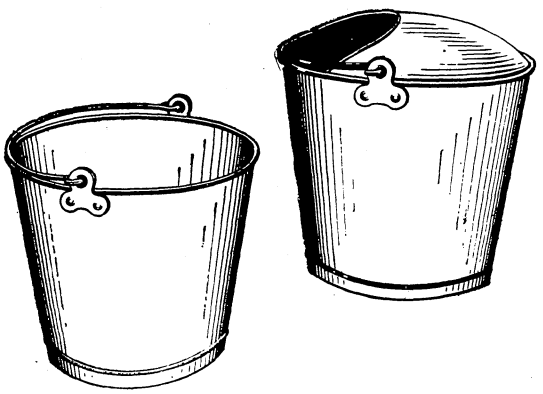

FIGURE 3.—Open-top and small-top milk pails

Many of the bacteria which get into milk from utensils are of undesirable types. Some of them cause milk to putrefy and undergo changes that may make it dangerous to health. If utensils have been washed in contaminated water and are not treated to destroy bacteria, disease bacteria may get into the milk.

Tightly covered milk or cream cans which have not been effectively treated with heat or a chlorine solution and dried give off foul odors after having stood for awhile. This is due to the action of the decay-causing bacteria on particles of milk solids left in the cans. If these cans are washed and thoroughly treated with heat or chlorine the foul odor will disappear. Utensils should be washed and subjected to heat, or a chlorine solution immediately after use to prevent the multiplication of great numbers of bacteria on their inner surfaces. In one experiment made by the bureau, milk contained 666,520 bacteria per cubic centimeter after coming

in contact with utensils which had not been treated with heat or a chlorine solution, even though they had been washed immediately after milking. In similar experiments, in which utensils were washed eight hours after they were used, the average bacterial count of the milk was 1,667,000, or more than a million greater than when the utensils were washed immediately after using.

Utensils should first be washed thoroughly, and then be further treated with heat or a chlorine solution to kill bacteria.

Rinse the utensils in cold or lukewarm water, then wash them with hot water, an alkali washing powder, and a stiff brush, until they are thoroughly clean. Next rinse them with clean water. Do not use rags, greasy soaps, or soap powders.

To kill the bacteria on the utensils, treat the utensils with steam or a chlorine solution, or immerse them in water and boil for 5 to 10 minutes. The last method, however, is cumbersome.

STEAMING UTENSILS

Where steam is used, equipment for this purpose should be installed. A metal tank mounted on a brick or masonry foundation, as shown in Figure 4, is satisfactory for small dairies. The tank has a false bottom. Enough water for washing utensils is put into the tank and then the fire is built. When the water is hot most of it is drawn off to use for washing, the amount remaining being only about an inch deep, and the water level is below the false bottom. After the utensils are washed they are placed in the tank on the false bottom. Then the tank is tightly covered. Steaming for 30 minutes is sufficient.

FIGURE 4.—Galvanized-iron box for heating water and for treating utensils to kill bacteria

A steam boiler furnishes the best source of heat for the heat treatment of utensils. The boiler may be connected with a cabinet [6] built of concrete, brick, stone, tile, metal, or wood. Steam the utensils in the cabinet for at least five minutes at a temperature of at least 200° F. They may be left in the cabinet until they are used.

Thorough drying of utensils after washing and steaming is extremely important. The steam coil in the bottom of the cabinet should give off enough heat to dry the utensils quickly.

To keep the temperature up to at least 200° F. the constant use of a thermometer is advised. As some types of apparatus generate steam

[6] Plans for the construction of a steam cabinet can be obtained free from the Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.

slowly, the length of exposure at 200° F. should be noted rather than the time the cabinet is in operation.

CHEMICAL TREATMENT OF UTENSILS

The chemicals that are commonly used for treating utensils to kill bacteria are sodium hypochlorite, calcium hypochlorite (also known as chloride of lime) and chloramine preparations. These can be bought in packages of convenient size.

In making a solution of calcium hypochlorite, first make a smooth, watery paste of 12 ounces of chloride of lime, and then add water, first in small quantities and then in larger quantities until the solution amounts to 2 gallons. Strain this into a glass bottle or jar, and keep tightly covered in a cool, dark place. This is called the stock solution. To dilute this stock solution to the proper strength for using, add water to it at the rate of 8 gallons of water per pint of stock solution. This is the final rinse solution. Never keep this solution from one day to the next, but make it fresh every day, and use it only once.

Commercial powders, tablets, and solutions for treating utensils are now on the market. These may cost more than the homemade solution, but in using them it is not necessary to make the stock solution, as they are in a form ready to add to the rinse water.

It is very essential to wash and rinse utensils thoroughly before putting them in the chlorine solution. Chlorine, the active agent in these solutions, is affected by organic matter, and if milk, cream, or dirt is present the strength of the solution is weakened before the chlorine has a chance to attack the bacteria.

The effectiveness of the solution depends upon its strength and the length of time the utensils are left in it.

A strength of 1 part of chlorine to 5,000 parts water is recommended. Be sure that the utensils are entirely covered with the solution, and that they are immersed in the solution for at least two minutes. Eliminate all air pockets. Never rinse the utensils after using the chlorine solution. Turn the utensils upside down in a clean, dry place, free from dust and flies (preferably in the milk house), and do not touch them until they are needed.

THE MILKING MACHINE MUST BE SANITARY

The parts of the milking machine which need the most attention are the rubber tubing, teat cups and inflations, claw, pail, head, valves, and moisture trap.

The heat method is simple and effective. This method is as follows:

Immediately after milking, rinse the machine with cold or lukewarm water drawn through it by vacuum. The flow of water may be broken occasionally by pulling the teat cups out of the water. Do this 10 or 12 times. Repeat this operation, using hot water containing washing powder, and wash the teat cups and tubing with a brush. Then rinse the machine by drawing clean hot water through it by vacuum.

Remove the long milk tube, with claw and teat cups, from the head of the pail. With a machine of the inflation type, plug the air tubes and put these parts in a tank or can. If steam is available, entirely cover all parts with clean water, and heat with steam to a

temperature of 160° to 165° F. If steam is not available, heat the water on a stove, but do not put the rubber parts in the water while it is heating. Leave the parts in the water until the next milking, allowing them to cool slowly.

In treating the parts with chemicals, wash them as indicated above. Instead of putting the parts in hot water, however, put them in a chlorine solution, of the same strength as used for other utensils, and allow them to remain there until the next milking.

With either method the machine should be taken entirely apart at least twice a week and washed thoroughly with brushes and hot water containing washing powder.

The moisture trap, or check valve, on the head of the machine should be cleaned every day.

Milking-machine pails and covers should be thoroughly washed after every milking and then be further treated with heat or a chlorine solution to kill bacteria. If there are pulsators and electric motors on the head of the pail they should be removed before cleaning the machine.

The vacuum line should be cleaned at least twice a year, by drawing hot water containing washing powder through it with vacuum. The vacuum line should be cleaned immediately after milking if milk has been drawn into it.

COOL THE MILK PROMPTLY AND KEEP IT COOL

A large number of bacteria found in milk when it reaches the consumer are due to improper cooling and keeping the milk at too high a temperature during storage, transportation, and delivery. The rapidity with which bacteria multiply in milk at different temperatures is shown in Table 1.

TABLE 1.—*Growth of bacteria in milk when the milk is held at 50° and at 68° F.*

Temperature of milk	Number of bacteria per cubic centimeter—				
	At beginning	At end of 6 hours	At end of 12 hours	At end of 24 hours	At end of 40 hours
50° F	10	12	15	41	62
68° F	10	17	242	61,280	3,574,990

At the above rate, if the milk, when produced, contained 1,000 bacteria per cubic centimeter, the part held at 50° F. would have contained only 4,100 bacteria at the end of 24 hours, whereas that held at 68° F. would have contained 6,128,000. The effect of temperature on the growth of bacteria is graphically shown in Figure 5.

At a certain creamery, milk received in the morning consisted of the previous night's milk and the fresh morning's milk, which were kept separate. During the six warm months (April to September, inclusive) 478 samples of the morning's milk averaged 800,026 bacteria per cubic centimeter, whereas 366 samples of milk which had been held overnight on the farms averaged 2,406,357 bacteria.

A survey of the temperatures at which milk is received at railroad stations for shipment to market in summer, showed that the temperature of morning's milk averaged about 60° F. and in some cases it was as high as 80° F. These temperatures are much too high to permit milk to be shipped a considerable distance without souring. Frequently it was found that morning's milk was rushed from the farm to the station before it had been sufficiently cooled. A large part of the loss caused by the souring of milk is due to the shipping of the milk at too high a temperature.

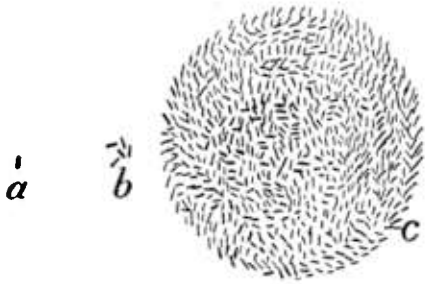

FIGURE 5.—This shows how rapidly bacteria multiply in milk that has not been properly cooled. In 24 hours a single bacterium (*a*) became 5 bacteria (*b*) in milk kept at 50° F. When the temperature of the milk was kept at 70° the single bacterium multiplied to the great number shown in (*c*) in the same length of time, 24 hours

Milk or cream must be cooled promptly to a temperature of 50° F. or below if rapid bacterial growth is to be prevented. The use of a surface cooler (fig. 6) is especially necessary when the time between milking and shipping is short. If warm milk is run over a surface cooler supplied with the coldest available water and then set in a tank cooled with ice to 40° F. or below, it should not be difficult to cool the milk to 50° within an hour after it leaves the cow. A 10-gallon can of warm milk precooled with water at 55° F. and set in a tank of ice water at 37° F. can usually be cooled to 50° F. in about 20 minutes. The fact that precooling with a surface cooler is not practiced and that ice is not put into the cooling tank until after the milk is put there, is the reason why much milk reaches the shipping station in summer at so high a temperature that it sours on the way to the city.

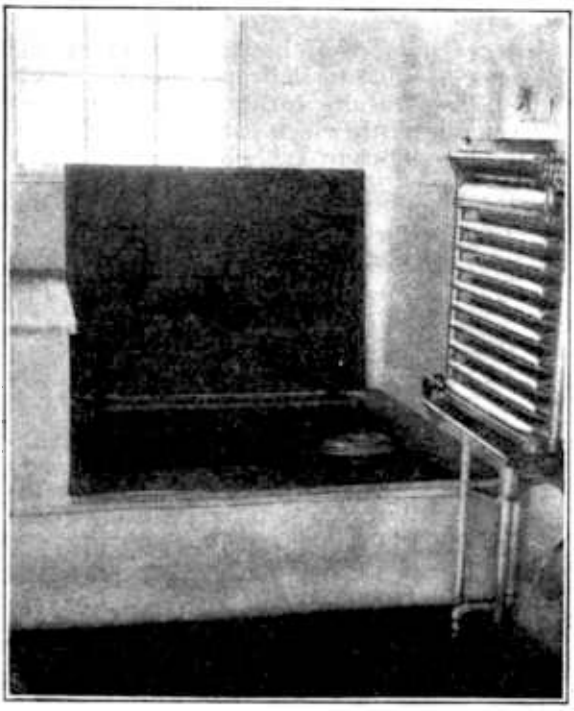

FIGURE 6.—Milk cooler and concrete tank for cooling and storing milk and cream

Do not mix warm, fresh milk with cold milk of the previous milking, because the addition of warm milk to cold hastens bacterial growth by warming up the whole mass. Keep cans of milk covered to prevent the entrance of dust, dirt, insects, and other sources of contamination.

Cream sours more slowly than milk. Heavy, or rich cream does not sour as quickly as thin cream; therefore, ordinarily, the cream should test from 30 to 35 per cent butterfat. Such cream makes less bulk to handle, and leaves more skim milk on the farm than does thin cream.

Immediately after cream is separated, cool by the same methods advised for milk. If only a small quantity is handled, put it into tall cylindrical cans, called "shotgun" cans, and place these in ice water. Do not mix fresh cream with previous skimmings until it has been thoroughly cooled.

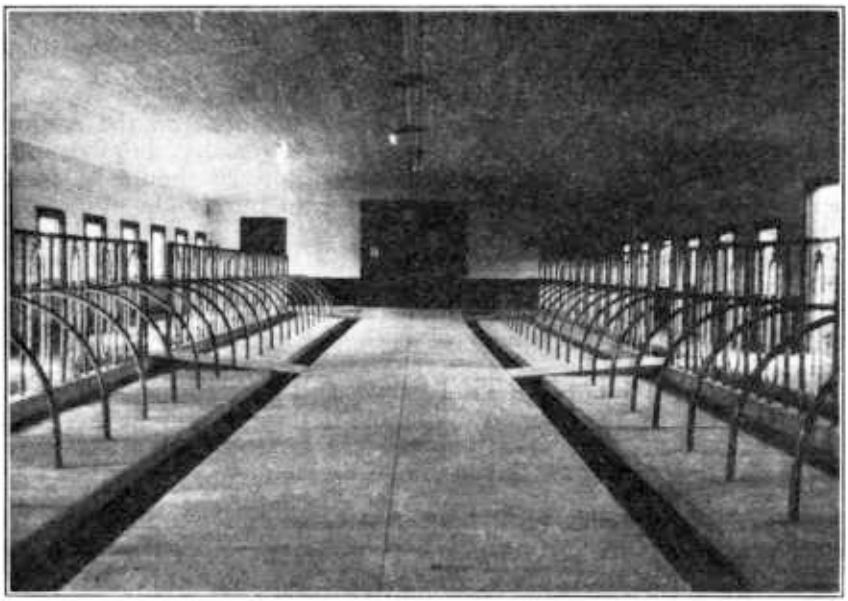

FIGURE 7.—Interior of a good dairy stable. Construction, equipment, lighting, ventilation, etc., of this kind make it easy to keep the floor, walls, ceiling, and stable fittings clean and sanitary

STABLE SHOULD BE CLEAN, WELL LIGHTED, AND WELL VENTILATED

Whenever possible the cow stable should be located on high ground with good natural drainage, and poultry houses, privies, hog sheds, manure piles, or other conditions which pollute the stable air and furnish breeding places for flies should not be close to it. A good location for a barnyard is on a south slope which drains away from the stable. If the barnyard tends to be muddy this may be remedied by drainage and by the use of cinders or gravel. A clean yard is a great help in keeping the cows clean. Figure 7 shows the interior of a substantial, practical, and well-constructed dairy barn, the plans and specifications for which were furnished by the Bureau of Dairy Industry.

The stable should have a hard, waterproof floor which can be easily cleaned. A dirt floor is very undesirable. A concrete floor is easy to clean and prevents waste of the liquid manure; however, such a floor tends to be cold but extra bedding will remedy this trouble. See that the gutter back of the cows is large enough to hold the droppings; a width of from 16 to 18 inches and a depth of 7 inches usually is sufficient. The gutter should slope so as to drain readily, unless the liquid manure is taken up by absorbents.

Types of stalls and mangers which have the least possible surface for collecting dust and dirt and offer the least obstruction to the circulation of air, are the most satisfactory. Wooden stalls have many surfaces and cracks which are hard to keep clean, and in case of disease they can not be disinfected as thoroughly as can stalls made of metal pipes. A swing stanchion is usually preferred, as it allows the cow plenty of freedom. A low, smooth manger without sharp angles is easy to keep clean. If the cows face the middle of the barn, the walk behind them should be 5 feet or more in width so that the walls will not be soiled by the spattering from the gutter or the manure carrier.

Tight, smooth ceilings and smooth walls without ledges are easily kept free from cobwebs, dust, and dirt. Cobwebs on the ceilings and manure on the walls are found in too many dairy stables. Unless walls and ceilings are painted, whitewash should be freely applied at least twice a year, as it helps to purify the stable and to keep it light.

A cow stable should be well lighted; 4 square feet of glass per cow is sufficient if the windows are well distributed and not obstructed in any way. If the stable is built with its length north and south, it gets the benefit of both the morning and afternoon sun.

The stable air should always be fresh and pure but should be free from drafts. If the odor in the stable is disagreeable at any time, it shows that the ventilation is poor. At least 500 cubic feet of air space should be provided in the stable for each cow.

MILK HOUSE SHOULD BE CLEAN AND CONVENIENT

The building in which the milk is handled should be convenient to the barn, but so located as to be free from dust and stable odors (fig. 8). The ideal place for it is in a well-drained location somewhat higher than the barn. It should not be close to the barnyard, pigpen, privy, or other source of contamination. The milk house may be connected with the stable by a covered, well-ventilated passageway with self-closing doors at each end to prevent stable odors from entering. It may be in the same building as the stable, but if so it should have a separate outside entrance and the walls should be tight and without a direct communicating door or window.

It is advisable to divide the milk house into two rooms, one for handling the milk and the other for washing the utensils. Plan the milk house and all its equipment so as to save as much labor as possible, not only in handling the product but in keeping the building clean.

There should be no unnecessary ledges or rough surfaces inside the building. The floors should be of concrete and pitched to drain

through bell traps. Rounded edges at the walls prevent the collection of dust and dirt. The walls and ceilings may be made of matched boards, but smooth cement plaster on metal lath is better. Ventilators are necessary to keep the air in the milk room fresh and free from musty and undesirable odors and to carry off steam from the wash room. Windows are very important, as they let in fresh air and sunlight and make work easier. In summer the doors and windows should be screened to keep out flies and other insects.

A plentiful supply of cold, running water in the milk house is necessary. The supply may be piped from an elevated tank fed by a windmill, engine, hand pump, or hydraulic ram. The dairyman can not afford to spend his time in carrying water in a pail to cool the milk and wash the utensils. Provision must also be made for supplying an abundance of hot water for washing and treating the utensils.

FIGURE 8.—A sanitary milk house, built according to plans recommended by the United States Department of Agriculture

USE UTENSILS THAT ARE EASILY CLEANED

All milk utensils should be durable, smooth, and nonabsorbent. Wooden utensils are hard to keep free from bacteria and should never be used. Badly battered or rusty utensils are hard to clean, and the rusty iron may injure the flavor of the milk and milk products. Do not use utensils having complicated parts, crevices, or places that are hard to clean.

MILKERS SHOULD BE CLEAN

Just before milking, each milker should wash his hands with soap and water and put on a pair of clean overalls and a jumper, or a suit which is used for no other purpose. Enough suits should be provided so that a clean one is always available. They should be washed regularly, and occasionally they should be steamed or boiled. Even the milking stool should be kept clean to avoid soiling the milker's hands.

Milk only with clean, dry hands, or with a milking machine which has been properly cleaned and treated to kill bacteria. The practice of wetting the hands with milk is a filthy one; it adds bacteria and sediment to the milk, and in the winter it may cause the cows' teats to chap. Milk quickly and thoroughly, without jerking the teats.

Immediately after each cow is milked, take the pail of milk to the milk house. Never let it stand in the barn. The milker should always bear in mind that he is handling a human food which is very easily contaminated. Therefore, it is well for the milker to have soap, clean water, and towels accessible so he can wash his hands after milking each cow.

STRAIN MILK PROPERLY

After the milk is taken to the milk house, strain and cool it at once. The straining is best done through a layer of sterile absorbent cotton placed between two clean strainer cloths which have been steamed or boiled, or through special straining cloth. Straining milk improves its appearance but does not remove the bacteria carried into it by dirt; therefore, dirt should be kept out of milk by clean methods. Keep a supply of clean strainer cloths on hand at all times, so that when one becomes soiled it can be replaced immediately with a clean one. Use a strainer cloth for only one milking. Special strainer cloths may be bought at low cost from most dealers in dairy supplies.

KEEP FEED AND WEED FLAVORS OUT OF THE MILK

Milk is often made unsalable by feed and weed flavors. Feed flavors in milk are most frequently caused by succulent feeds. When fed to dairy cows one hour before milking, silage made from corn, alfalfa, sweetclover, or soybeans, and green alfalfa, cabbage, turnips, rape, and kale seriously affect the flavor and odor of milk. Green rye, green cowpeas, potatoes, dried beet pulp, and carrots affect the flavor and odor of milk only slightly, and green corn, green oats and peas, green soybeans, pumpkins, and sugar beets have practically no effect on the flavor and odor.

Feeds affect the flavor of milk only a few hours after they are eaten. For this reason, feed dairy cows highly flavored feeds immediately after milking and not just before. Aeration of milk by running it over a surface cooler immediately after milking reduces strong feed flavors and sometimes eliminates slight ones.

Eradicate from pastures all weeds which cause objectionable flavors in milk. Until this is done take the cows off infested pastures as long as possible before milking. The longer the interval between the removal of the cows from pasture and the time of milking, the less intense will be the undesirable flavors in the milk. In the case of garlic-infested pastures the cows should be taken off the pasture four to seven hours before milking to entirely avoid the garlic flavor and odor in milk. Some weeds, such as bitterweed, impart objectionable flavors to the milk several hours after they are eaten. If such weeds are present it may be necessary to keep the cows off the pasture until the weeds are eradicated.

ADDITIONAL INFORMATION

The following United States Department of Agriculture publications have a direct bearing on the general subject of sanitation in milk production. A copy of any of these publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices indicated.

PUBLICATIONS

734–F, Flytraps and Their Operation. 5¢.
954–F, Disinfection of Stables. 5¢.
976–F, Cooling Milk and Cream on the Farm. 5¢.
1069–F, Tuberculosis in Livestock: Detection, Eradication, and Control. 5¢.
1097–F, The Stable Fly: How to Prevent Its Annoyance and Its Losses to Livestock. 5¢.
1214–F, Farm Dairy Houses. 5¢.
1227–F, Sewage and Sewerage of Farm Homes. 5¢.
1315–F, Cleaning Milking Machines. 5¢.
1393–F, Principles of Dairy-Barn Ventilation. 5¢.
1408–F, The House Fly and How to Suppress It. 5¢
1422–F, Udder Diseases of Dairy Cows. 5¢.
1426–F, Farm Plumbing. 5¢.
1448–F, Farmstead Water Supply. 5¢.
3–L, Improved Sanitation in Milk Production. 5¢.
25–L, Preventing Feed Flavors and Odors in Milk. 5¢.

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